OPERATING INSTRUCTIONS 1263-A

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TYPE 1263-A AMPLITUDE-REGULATING POWER SUPPLY

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OPERATING AND MAINTENANCE INSTRUCTIONS

TYPE 1263-A AMPLITUDE-REGULATING POWER SUPPLY

Form 882-A
May, 1955

GENERAL RADIO COMPANY

275 MASSACHUSETTS AVENUE

CAMBRIDGE 39 MASSACHUSETTS

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SPECIFICATIONS

Power input	55 watts maximum, at 115 or 230 volts, 50 or 60 cycles.
Output plate supply	250 volts at 25 milliamperes with line voltage 105 to 115 (or 210 to 230). Up to 300 volts at 30 milliamperes available up to 125- (or 250.) volt line.
Output heater supply	6 volts d-c at 0.5 ampere with 115- or 230-volt line (5.4 volts at 0.7 ampere).
R-f output regulation	Output control permits level to be regulated from 0.2 to 2 volts. The output of an oscillator is regulated to within 2% of the preset level over its frequency range (subject to possible output rectifier errors), providing oscillator can deliver at least 2 volts with a 300-volt, 30-milliampere plate supply at all frequencies in its range.
Response time	Plate current is changed at a rate of 3 ma per millisecond to correct for output variations.
Tubes supplied	Type 12AX7 (three), Type 6V6-GT (one), Type OA2 (one), Type 6X4 (one).
Accessories supplied	Power cord, connection cable for modulation jack on oscillator, multipoint plug for connecting oscillator not equipped with proper power plug, spare fuses.
Other accessories required	R-f output rectifier that delivers a negative d-c potential to control Power Supply (Type 874-VR Voltmeter Rectifier is recommended; shielded cable for connecting output rectifier to Power Supply (Type 274-NF Patch Cord is recommended).
Height (panel)	13-1/4 inches
Width (panel)	8-1/4 inches
Depth (behind panel)	7-1/4 inches
Weight	18-1/2 pounds

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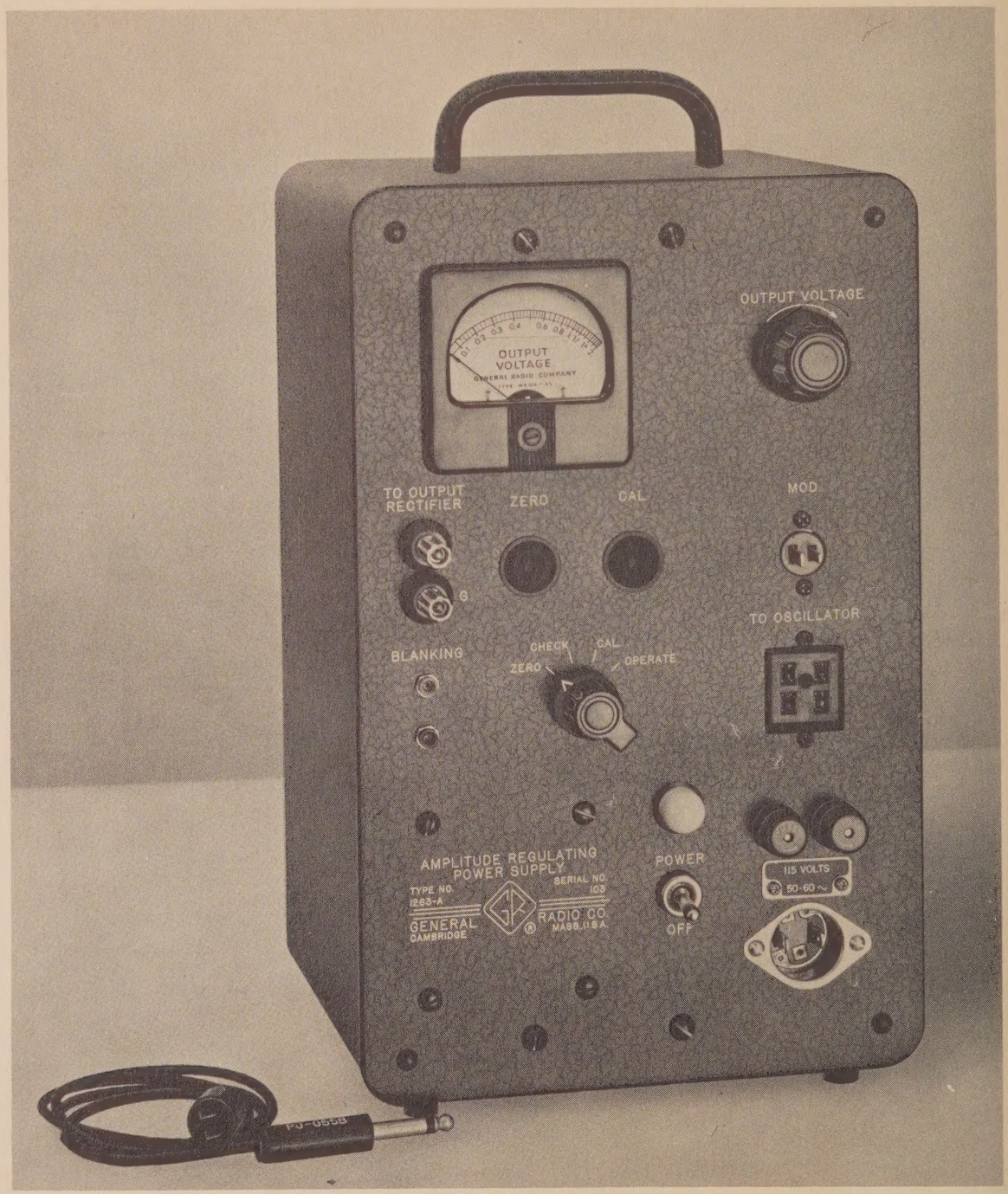


Figure 1. Type 1263-A Amplitude-Regulating Power Supply, Front View.

OPERATING AND MAINTENANCE INSTRUCTIONS

for

TYPE 1263-A

AMPLITUDE-REGULATING POWER SUPPLY

Section 1.

INTRODUCTION

1.1 PURPOSE. The Type 1263-A Amplitude-Regulating Power Supply (Figure 1) is designed to operate General Radio Unit Oscillators or oscillators with similar power requirements. This Power Supply automatically varies the plate current supplied to an oscillator to maintain the r-f output voltage constant at a preset level. This constant output is of great advantage in frequency response measurements, and is particularly important when the oscillator frequency dial is mechanically swept so that the response can be plotted by means of an oscilloscope or recorder. The oscillator must have suitable connections for application of a modulating voltage (as with General Radio Unit Oscillators). There must also be available an output rectifier supplying a negative d-c potential. In Figure 2, a Type 1263-A Amplitude-Regulating Power Supply is shown with a Type 1750-A Sweep Drive, driving a Type 1209-B Unit Oscillator. The Type 1263-A Amplitude-Regulating Power Supply was designed especially for use with oscillators driven by the Type 1750-A Sweep Drive, but is also useful with manually operated oscillators.

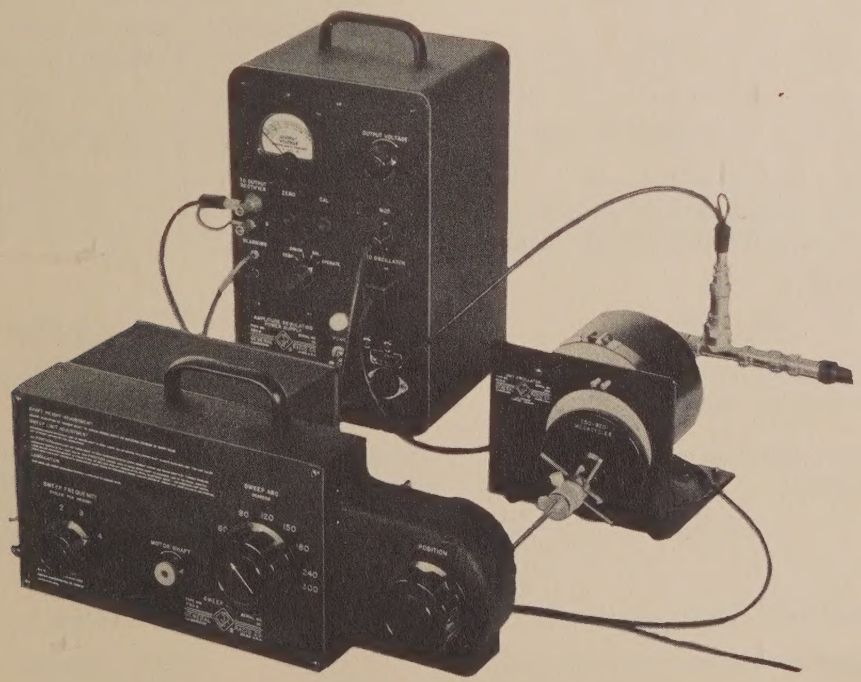


Figure 2. Type 1263-A Amplitude-Regulating Power Supply and Type 1750-A Sweep Drive shown driving a Type 1209-B Unit Oscillator.

1.2 DESCRIPTION.

1.2.1 TERMINALS. The following terminals are provided on the panel of the Type 1263-A Amplitude-Regulating Power Supply:

Name	Description	Use
TO OSCILLATOR	Four-terminal, multi-point socket	Direct plug-in connection for power cables of General Radio Unit Oscillators. (For other oscillators, a four-terminal mating plug is provided.)
MOD.	Two-terminal plug	Connection to modulation terminals of oscillator. For General Radio Unit Oscillators, connection is via patch cord with two-terminal socket on one end and telephone plug on other end. For other oscillators and older General Radio Unit Oscillators, remove the telephone plug or add telephone jack.
TO OUTPUT	Binding post (red bushing)	Connection to rectifier negative d-c potential by shielded cable.
RECTIFIER	Binding post (black bushing)	Shield and return circuit. Connect to rectifier by shielded cable. NOTE: These terminals provide check points for observing dynamic regulation of the power supply in sweep applications.
BLANKING	Telephone-tip jacks (two)	Connection for an external contactor to blank or cut off oscillator output. Used in sweep applications to eliminate return trace and provide a zero reference base line on sweep display.
	Recessed plug	Connection for a-c power, through detachable line cord.

1.2.2 CONTROLS. The following controls are on the panel of the Type 1263-A Amplitude-Regulating Power Supply:

Name	Description	Positions	Function
POWER	Two-position toggle-switch with pilot light	POWER, OFF	Energizes power supply
	Four-position selector switch	ZERO, CHECK CAL., OPERATE	Permits output voltmeter to be checked and calibrated with output rectifier in use, without disturbing any connections to oscillator.
ZERO	Recessed thumb-set control		Output voltmeter zero adjustment.
CAL.	Recessed thumb-set control		Output voltmeter calibration adjustment.
OUTPUT VOLTAGE	Rotary knob		Sets output level.

1.2.3 METER. The meter in the upper left-hand corner of the panel indicates the output voltage set by the OUTPUT VOLTAGE control, and is the means of checking the regulating action of the power supply. The meter is an internal d-c vacuum-tube voltmeter, calibrated in terms of r-f output voltage. A quasi-logarithmic scale covers an output voltage range of 0.1 to 2. An internal calibration means permits the meter to be standardized with a particular output rectifier. By means of a panel selector switch, calibration and zero adjustments (thumb-set controls; refer to paragraph 1.2.2) can be made quickly without disturbing connections to the oscillator.

1.2.4 FUSES. Line fuses are accessible from the panel. One-ampere, "slow-blow" fuses are used for 115-volt operation, and 1/2-ampere, "slow-blow" fuses are used for 230-volt operation.

1.2.5 ASSOCIATED EQUIPMENT.

1.2.5.1 Unit Oscillator. The following is a list of recommended General Radio Unit Oscillators:

Type No.	Frequency Range
1211-B	0.5 to 5 Mc; 5 to 50 Mc
1215-B	50 to 250 Mc
1209-B	250 to 920 Mc
1218-A	900 to 2000 Mc

The earlier "A" models of the Type 1211, 1215, and 1209 Unit Oscillator will operate satisfactorily with the Type 1263-A Amplitude-Regulating Power Supply if the modulation telephone plug is removed or is adapted to connect to the screw-terminals on these instruments. The Type 1208-A and 1208-B Unit Oscillator cannot be used with the Type 1263-A Amplitude-Regulating Power Supply. Other oscillators with suitable power requirements can be operated from this power supply if a d-c connection can be made to the cathode circuit to apply plate-current control.

1.2.5.2 Output Rectifier. The General Radio Type 874-VR Voltmeter Rectifier is recommended for use as the output rectifier over the frequency range of 0.5 to 2000 megacycles. It is equipped to plug directly into the output connector of General Radio Unit Oscillators, and provides a matched source for 50-ohm coaxial cable. The back resistance of the crystal diode should exceed 20,000 ohms. The ripple in the output of the rectifier must be less than 10 percent at frequencies above 0.5 megacycle to prevent overloading the control amplifier. When the Type 874-VR Voltmeter Rectifier is used, the response time is essentially determined by the internal compensation in the Power Supply. The stability of the control system (freedom from hunting and oscillation) is determined by the design of this compensation. Rectifiers duplicating the characteristics of the Type 874-VR Voltmeter Rectifier require no additional compensation. For operation below 0.5 megacycle, special consideration must be given to the output-rectifier filtering to maintain stability, and the ripple voltage must be considerably lower than that permissible at the higher frequencies. In such applications, the design of a special rectifier system must be undertaken.

1.2.5.3 Sweep Drive. The General Radio Type 1750-A Sweep Drive can be used with oscillators operating from the Power Supply to produce a sweeping frequency source with constant r-f output over the sweep range. This Sweep Drive also provides a blanking contactor and a cathode-ray oscilloscope deflection voltage synchronized with the position of the driven dial.

Section 2.

THEORY OF OPERATION

2.1 GENERAL. The Type 1263-A Amplitude-Regulating Power Supply compares the d-c potential developed by the oscillator output rectifier with a d-c reference potential, and applies a correction to the oscillator plate supply to minimize the difference. The load resistance presented to the output rectifier is 100,000 ohms. A maximum of 300 volts at 30 milliamperes is available for the oscillator plate. The d-c reference potential is adjustable from zero to 2.5 volts, which corresponds to an r-f output of zero to 2 volts with the normal output rectifier. This power supply will maintain any preset level within two percent over the frequency range (subject to possible errors of the output rectifier), provided that the oscillator produces at least 2 volts with a 300-volt, 30 milliampere plate supply at all frequencies within its range.

2.2 CIRCUIT. The elementary schematic diagram (Figure 3) illustrates the principles of operation of the Power Supply. The output rectifier develops a negative d-c potential proportional to the r-f amplitude at the oscillator output. This potential is applied to the voltmeter amplifier and to one grid of the first difference amplifier. An adjustable negative reference potential is applied to the other grid of the first difference amplifier. An increase in the negative potential developed by the output rectifier, with respect to the reference potential, is amplified by the two difference amplifiers, and appears as an increased negative potential at the output amplifier grid. This reduces the plate current supplied to the oscillator. Conversely, a decrease in output produces an increase in plate current applied. A closed-circuit feed-back system is thereby estab-

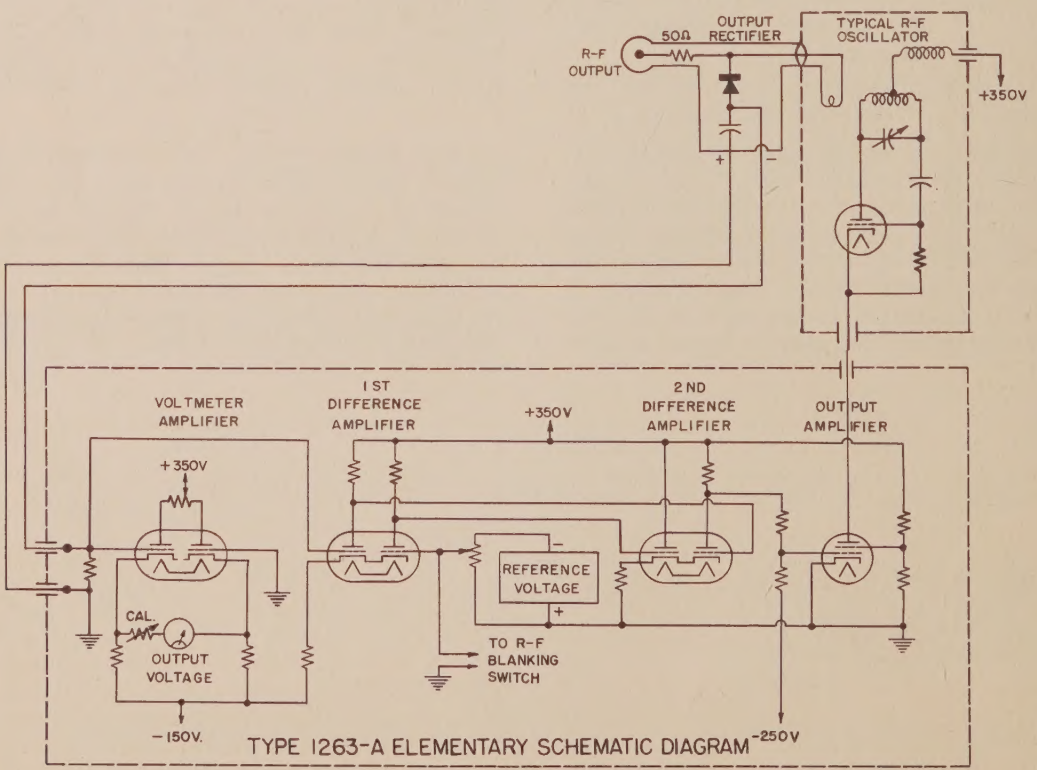


Figure 3. Elementary Schematic for Type 1263-A Amplitude-Regulating Power Supply.

lished, which holds the output close to a preset level. R-f blanking is accomplished by shorting the reference potential with an external contactor.

2.3 RESPONSE TIME. In sweep applications, rapid variations of the oscillator output are likely to occur, particularly in the u-h-f range. These variations must be virtually eliminated by an amplitude regulator. The Type 1263-A Amplitude-Regulating Power Supply will change the plate current applied at a rate of 3 milliamperes per millisecond or faster. For an oscillator requiring 30 milliamperes at 300 volts, this corresponds to a change of 30 volts per millisecond. The oscillator must not be swept at a speed that requires a rate of plate-voltage change exceeding this value. General Radio Unit Oscillators can be swept through their entire ranges in a sinusoidal manner at rates up to one cycle per second. Fractional parts of the oscillator ranges can, of course, be swept at correspondingly faster rates.

Section 3.

INSTALLATION

3.1 CONNECTIONS. (Refer also to Section 1.2.5.)

3.1.1 GENERAL RADIO UNIT OSCILLATORS. Plug the Unit Oscillator power cable into the multipoint connector on the panel of the Power Supply. With the patch cord supplied, connect the MOD. plug on the Power Supply to the modulation jack of the Unit Oscillator.

3.1.2 OTHER OSCILLATORS. Connect the oscillator to the Power Supply with the mating plug supplied. Remove the plug on the patch cord, and make the connections described below.

In the Power Supply, the high terminal of the MOD. plug leads to the plate of the output amplifier. The low MOD. terminal is ground. The potential drop must be from the high terminal to ground to provide proper potential for the output amplifier. There are two ways of connecting the oscillator and plate supply: (1) Connect the high MOD. terminal to the oscillator cathode d-c connection. Connect the positive terminal of the plate supply to the plate d-c connection. Connect the negative terminal to the low MOD. terminal. (2) Connect the cathode d-c connection to the negative terminal of the plate supply. Connect the positive terminal of the plate supply to the high MOD. terminal. Connect the oscillator plate connection to the low MOD. terminal.

CAUTION

Excessive voltage, even if applied for a short time, can damage crystal diodes. Do not apply a-c power to the Power Supply until all connections between oscillator, output rectifier, and Power Supply have been made. When using the Type 1211-A or 1211-B Unit Oscillator, turn the selector switch on the Power Supply to CAL. while changing frequency range.

3.1.3 OUTPUT RECTIFIER CONNECTION. Connect the Power Supply to the output rectifier with a shielded cable. A Type 274-NF Patch Cord and a Type 874-Q6 Adaptor are recommended for use with the Type 874-VR Voltmeter Rectifier. This combination provides necessary shielding and frees the Power Supply binding posts for connection of a cathode-ray oscilloscope. The direct, plug-in connection of the Type 874-VR Voltmeter Rectifier is recommended. Adaptors are available for other standard connectors. The resistor end of the Voltmeter Rectifier, marked "R", should face the load to provide a matched source for 50-ohm coaxial line.

3.2 HEATER-SUPPLY VOLTAGE ADJUSTMENT. There is a considerable variation in the heater current requirements of various oscillators. In Unit Oscillators, a compromise in voltage supplied permits satisfactory operation without adjustment. Six volts are supplied at 0.5-ampere load current with the nominal line supply voltage. Heater current requirements for oscillators are met as follows:

a. Types 1209-B and 1215-B: 6.3 volts supplied at between 0.3 and 0.4 ampere meets requirement.

b. Type 1211-B: 5.4 volts supplied at 0.7 ampere satisfactory. (6 volts at 0.75 ampere required.)

c. Type 1218-A: Has internal heater rectifier. Polarity of dc supplied by Type 1263-A Power Supply so chosen that this rectifier conducts. Oscillator current requirement less than 0.2 ampere. The drop in the rectifier and associated filter is such that proper voltage is supplied to the tube.

d. Other oscillators (1) requiring less than 0.2 ampere at 6.3 volts: Remove jumper (inside Power Supply) that normally short-circuits resistor R54. (2) requiring up to 1 ampere at 6 volts: Shunt L1 with a suitable resistor. (2-ohm, 5-watt resistor required for 1 ampere at 6 volts.)

Section 4.

OPERATING PROCEDURE

4.1 INITIAL ADJUSTMENT. After the proper connections have been made to the oscillator and the output rectifier (refer to paragraphs 1.2.5 and 3.1), apply power and check operation as follows:

a. Standardize the output voltmeter.

(1) With the selector switch in the ZERO position, turn the ZERO thumb control to produce a zero meter indication.

(2) Turn the selector switch to CHECK and observe the meter indication.

(3) Turn the selector switch to CAL. and turn the CAL. thumb control to produce the same indication as noted in (2).

b. Turn the selector switch to OPERATE.

c. Set the OUTPUT VOLTAGE control to the desired operating level. If it is impossible to reach this level by advancing the OUTPUT VOLTAGE control, the oscillator cannot supply this output. As the normal oscillator output coupling is reduced, the drop-out point of the regulator will occur abruptly, with no noticeable change in level down to this point, if the system is operating properly.

If, with normal plate supply, the output from the oscillator is much greater than the desired operating level, the control system may become unstable and break into oscillation. This condition can easily be observed either on an oscilloscope connected to the output rectifier binding posts, or by the action of the output meter as the oscillator output coupling is varied. As the coupling (control or loop on the oscillator itself) is increased from the minimum setting, the indicated voltage should rise to the desired output level, then remain constant over a part of the range of the oscillator output coupling. Then, if the coupling can be advanced far enough, the meter will suddenly jump upward or downward, indicating the unstable oscillating condition. All General Radio Unit Oscillators are equipped with an adjustable output coupling system, so that the above tests can be made. Usually, a setting can be found that produces stable operation over a ten-to-one output voltage range and over the frequency range of the oscillator. Once the adjustments have been made, it should be possible to turn the oscillator dial through the entire frequency range with no noticeable fluctuation in output voltage.

4.2 SWEEP APPLICATIONS. If the oscillator is mechanically swept for automatic frequency response displays, the dynamic regulation of the output must be checked. The cathode-ray oscilloscope used to present the response is an excellent means of checking the operation of the power supply and of observing when optimum oscillator output coupling setting is obtained. When using the Type 1750-A Sweep Drive, connect the blanking cable to the BLANKING telephone-tip jacks on the Type 1263-A Amplitude-Regulating Power Supply to provide a zero reference base line for the desired response display and for the checking display. The horizontal input to the scope should be supplied with the oscilloscope sweep voltage provided by the sweep drive. Temporarily connect the vertical input to the OUTPUT RECTIFIER binding posts. Oscilloscope response must be good to dc for the normal speeds of a mechanical sweep drive. Drive the oscillator over the desired range, with the output voltage set at the desired level. Adjust oscilloscope sensitivity to give a suitable horizontal and vertical deflection. The pattern should be approximately rectangular, with the horizontal portions straight lines. The negative voltage horizontal portion represents the oscillator output characteristic, and the positive portion the zero level.

If the oscillator output characteristic is not shown as a horizontal straight line, adjust the oscillator output coupling, and, if necessary, reduce sweep speed. A broadening or burst of high-frequency voltage on this line indicates control system oscillation; to eliminate this, reduce the output coupling.

Sharp discontintuities in the output characteristic of the oscillator, particularly when wide frequency ranges are swept, may require a reduction in sweep speed so that the control-system response time will permit complete correction of output voltage. With General Radio Unit Oscillators, this reduction will not exceed the low-speed limit imposed by mechanical standards.

Once a flat horizontal line representing the oscillator output voltage characteristic is obtained, the oscilloscope vertical input can be transferred to the device under test with the assurance that the applied voltage is constant.

Section 5.

OUTPUT RECTIFIER ERRORS

5.1 RECTIFIER FREQUENCY CHARACTERISTIC. The ability of the Type 1263-A Amplitude-Regulating Power Supply to maintain a constant oscillator output is of necessity dependent on the characteristic of the output rectifier. The power supply maintains within close limits the rectified dc produced by the rectifier, but oscillator distortion and the frequency characteristic of the rectifier can cause errors. The most serious frequency characteristic of a rectifier used at a very high frequency is due to resonance in the diode circuit. In the recommended Type 874-VR Voltmeter Rectifier, the resonant frequency is approximately 3800 Mc. The actual output voltage is down from the indicated or regulated level approximately 10 percent at 1000 Mc, and 30 percent at 2000 Mc. Figure 4 illustrates the frequency characteristic of the Type 874-VR Voltmeter Rectifier with a typical crystal diode. Correction factors (obtained from Figure 4) must be used when the Type 1263-A Amplitude-Regulating Power Supply is operated with a 900-to-2000-Mc oscillator, such as the Type 1218-A Unit Oscillator.

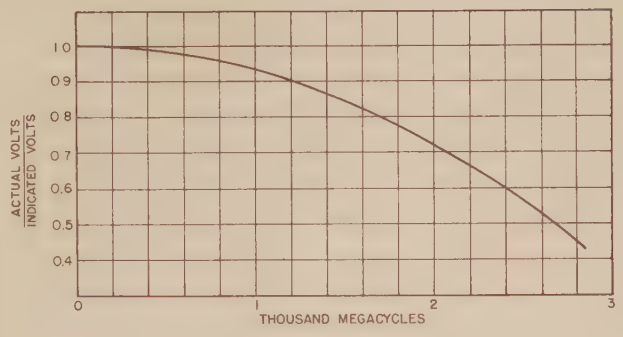


Figure 4. Resonance Correction Factors; Type 874-VR Voltmeter Rectifier.

5.2 HARMONIC FREQUENCY. Any harmonic frequency in the oscillator output falling at the resonant frequency of the diode will be greatly emphasized. This is particularly critical with oscillators operating above 500 Mc, where even small amounts of the lower-order harmonics can cause trouble. The harmonics generated by the recommended General Radio Unit Oscillators are quite low. Nevertheless, rapid deviations from the preset regulating level (approximately five percent above 500 Mc) may occur as harmonic frequencies of a sweeping oscillator pass through the resonant frequency of the diode rectifier.

Section 6.

SERVICE AND MAINTENANCE

6.1 TUBE REPLACEMENT. Refer to the tube location chart (Figure 5). Tube requirements are not particularly critical, although careful selection may be required for V4, since the cutoff bias of 6V6GT tubes can vary over wide limits. Refer to paragraph 6.2 to determine acceptability of tubes for this location. The important characteristic of V1, V2, and V3 is balance between sections. It is usually possible merely to interchange V1, V2, and V3 to obtain proper operation with a given set of tubes. The proper functioning of V2, which is the d-c amplifier, is checked by the meter standardization procedure described in paragraph 4.1a. If too great an unbalance exists between tube sections, it will be impossible to set the ZERO, and the tube must be replaced.

6.2 CALIBRATION. In addition to the normal operating adjustments described in preceding sections, there are two internal controls. One of these is a factory-set sealed control (R34) that will not require adjustment except with failure and replacement of RX1, R33, R34, R35, or R39. After replacing any of these parts, set the panel selector switch

in the CHECK position and adjust R34 so that the a-c potential at the binding posts is the same as that indicated on the panel voltmeter. The external calibrating meter must have a resistance of at least 1000 ohms.

The other calibrating control is R2. This is the BAL. control, and it should be so set that it is possible to cut off the output current supply. The adjustment, which may be required after tube replacement, should be made at the highest line voltage (125 or 250 volts). Adjustment is easiest with the power supply operating an oscillator. With the OUTPUT VOLTAGE control at the extreme counterclockwise position, turn R2 counterclockwise just beyond the point where the oscillator output reaches zero. If it is impossible to make this adjustment, check the negative bias V4 (terminal 5 to chassis) with a vacuum-tube voltmeter. If the voltage is less than 45 volts dc, interchange V1 and V3; if necessary, replace one or both of these tubes. If the voltage is 45 volts or more, replace V4.

6.3 SERVICE DATA. The following table shows voltages and resistances between various test points.

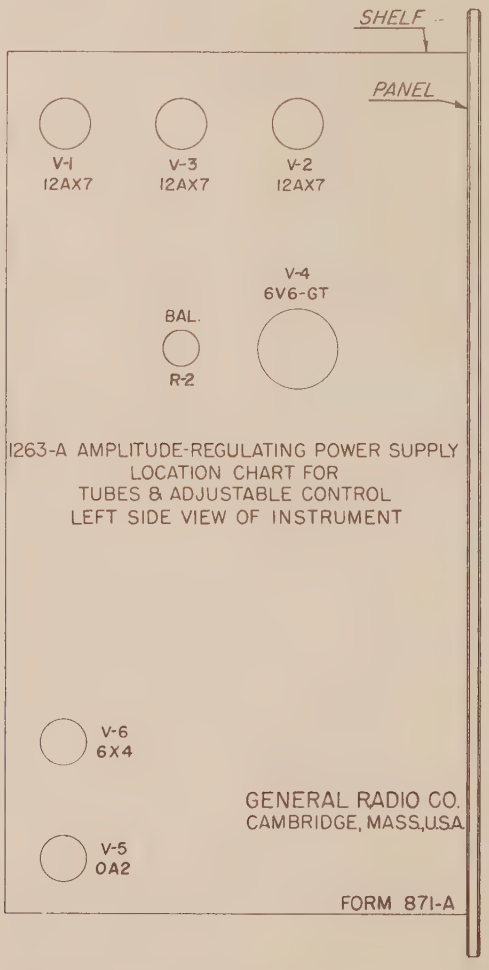


Figure 5. Tube Location Chart for Type 1263-A Amplitude-Regulating Power Supply.

TUBE	PLATE			CONTROL GRID			CATHODE		
	PIN	VOLTS TO GROUND	RESISTANCE TO GROUND	PIN	VOLTS TO GROUND	RESISTANCE TO GROUND	PIN	VOLTS TO GROUND	RESISTANCE TO GROUND
V1	1	165	420k	2	0.03	1100Ω	3	1.8	300k
(12AX7)	6	170	360k	7	0.03*	100k	8	1.8	300k
V2	1	320	0 - 100k**	2	-0.02*	3.4M	3	3.0	150k
(12AX7)	6	320	0 - 100k**	7	0	3.3M	8	3.0	150k
V3	1	320	0	2	83*	900k	3	85	100k
(12AX7)	6	135	430k	7	84*	900k	8	85	100k
V5	5	0	0	–	–	—	2	-150	0
(OA2)									
V6	1	310AC†	∞	–	–	—	7	400†	∞
(6X4)	6	310AC†	∞						
V4	3	0		5	-56	1.1M	8	0	0
(6V6GT)	V4 SCREEN GRID								
	4	210	6.5k						

*Use vacuum-tube voltmeter.
**Depends on setting of ZERO rheostat R10.
†Use terminal 16, socket SO1 as reference instead of ground.

NOTES:

Resistance Measurements:

1. Ground both B+ and B-
   (a) Ground junction of C1 and R50 (B+).
   (b) Ground pin 2, tube V5 (B-).
2. Set selector switch at OPERATE, and OUTPUT VOLTAGE control at counterclockwise end.
3. No external connection should be made at any socket.
4. Measure resistance from tube socket pin to ground.

Voltage Measurements:

1. Measure d-c voltages from tube socket pin to ground. The resistance of the meter must be at least 10 times the resistance to ground to keep the error small. (When using a meter with 20,000-ohm-per-volt sensitivity, multiply full-scale voltage of scale being used by the sensitivity, 20,000 ohms per volt, to obtain meter resistance.)

Section 7.

PARTS LIST

RESISTORS (See Note B)

				GR NO. (Note A)
R1	430 k	±5%	1/2w	REC-20BF
R2	100 k	±10%	2 w	POSC-11
R3	430 k	±5%	1/2w	REC-20BF
R4	1 k	±10%	1/2w	REC-20BF
R5	1 k	±10%	1/2w	REC-20BF
R6	100 k	±5%	1/2w	REC-20BF
R7	100	±10%	1/2w	REC-20BF
R8	3.3 k	±5%	1/2w	REC-20BF
R9	1 k	±10%	1/2w	REC-20BF
R10	100 k	±10%	2w	POSC-11
R11	1 M	±5%	1/2w	REC-20BF
R12	1 M	±5%	1/2w	REC-20BF
R13	2.7 M	±5%	1/2w	REC-20BF
R14	1 k	±10%	1/2w	REC-20BF
R15	3.3 M	±5%	1/2w	REC-20BF
R16	2.7 M	±5%	1/2w	REC-20BF
R17	1 k	±10%	1/2w	REC-20BF
R18	470 k	±5%	1/2w	REC-20BF
R19	1 k	±10%	1/2w	REC-20BF
R20	100 k	±5%	1/2w	REC-20BF
R21	4.3 k	±5%	1/2w	REC-20BF
R22	2.2 M	±5%	1/2w	REC-20BF
R23	1 k	±10%	1/2w	REC-20BF
R24	2.2 M	±5%	1/2w	REC-20BF
R25	18 k	±5%	2w	REC-41BF
R26	22 k	±5%	2w	REC-41BF
R27	22 k	±5%	2w	REC-41BF
R30	300 k	±5%	1/2w	REC-20BF
R31	1 M	±5%	1/2w	REC-20BF
R32	100 k	±5%	1/2w	REC-20BF
R33	4.7	±10%	1/2w	REW-3C
R34	10	±10%	2w	POSW-3
R35	47	±5%	1/2w	REW-3C
R36	300 k	±5%	1/2w	REC-20BF
R37	4.7 k	±10%	1/2w	REC-20BF
R38	25 k	±10%	2w	POSC-11
R39	56 k	±5%	1/2w	REC-20BF
R40	300 k	±5%	1/2w	REC-20BF
R41	470 k	±5%	1/2w	REC-20BF
R42	10 k	±10%	2w	POSC-12
R46	15	±10%	1/2w	REW-3C
R47	270	±5%	2w	REC-41BF
R48	1.5 k	±5%	2w	REC-41BF
R49	1.5 k	±5%	1w	REC-30BF
R50	1.5 k	±5%	1w	REC-30BF
R51	3.3 k	±5%	2w	REC-41BF
R52	3.3 k	±5%	2w	REC-41BF
R53	3.3 k	±5%	2w	REC-41BF
R54	5.1	±5%	2w	REW-6C
R55	75	±5%	2w	REW-6C
R56	270	±5%	2w	REW-6C
R57	150	±5%	1w	REW-4C
R58	270	±5%	2w	REW-6C
R59	120 k	±10%	2w	REC-41BF
R60	150	±5%	1w	REW-4C

CAPACITORS (See Note C)

			GR NO. (Note A)
C1	0.01	±10%	COL-71
C2	0.01	±10%	COL-71
C3	0.01	±10%	COL-71
C5	16	150 dcwv	COE-4
C6	0.005	+25% -10%	COU-31
C7	0.005	+25% -10%	COU-31
C8	50	450 dcwv	COE-10
C9	25		
C10	25		
C11	20	450 dcwv	COE-5
C12	20	450 dcwv	COE-5
C13	1500	10 dcwv	COE-9
C14	1500		
C15	50	450 dcwv	COE-10
C16	50		
C17	50	450 dcwv	COE-10
C18	50		

FUSES

		GR NO. (Note A)
F1	1 amp, Slow-Blow 3AG	FUF-1
F2	1 amp, Slow-Blow 3AG	FUF-1
F1	0.5 amp, Slow-Blow 3AG	FUF-1
F2	0.5 amp, Slow-Blow 3AG	FUF-1

RECTIFIERS

	GR NO. (Note A)
RX1	2RE-17
RX2	2RE-16
RX3	2RE-16
RX4	2RE-16
RX5	2RE-16
RX6	2RE-16
RX7	2RE-16
RX8	2RE-12

JACKS

	GR NO. (Note A)
J1	BP-5
J2	BP-5
J3	CDSJ-11R
J4	CDSJ-11B

MISCELLANEOUS

		GR NO. (Note A)
L1	Filter Choke	745-414
M1	Meter, 0 - 200 μa	MEDS-55
P1	Pilot Lamp	2LAP-939
PL1	Plug	CDPP-562A
PL2	Plug	CDMP-1264-2
S1	Switch	SWRW-20
S2	Switch, dpst	SWT-333NP
SO1	Socket	CDMS-11-4

NOTES

(A) Type designations for resistors and capacitors:

COE - Capacitor, electrolytic
COL - Capacitor, oil
COU - Capacitor, unclassified
POSC - Resistor, variable, composition
POSW - Resistor, variable, wire-wound
REC - Resistor, fixed, composition
REW - Resistor, fixed, wire-wound

(B) All resistances are in ohms, except as indicated by k (1000 ohms) or M (1,000,000 ohms).

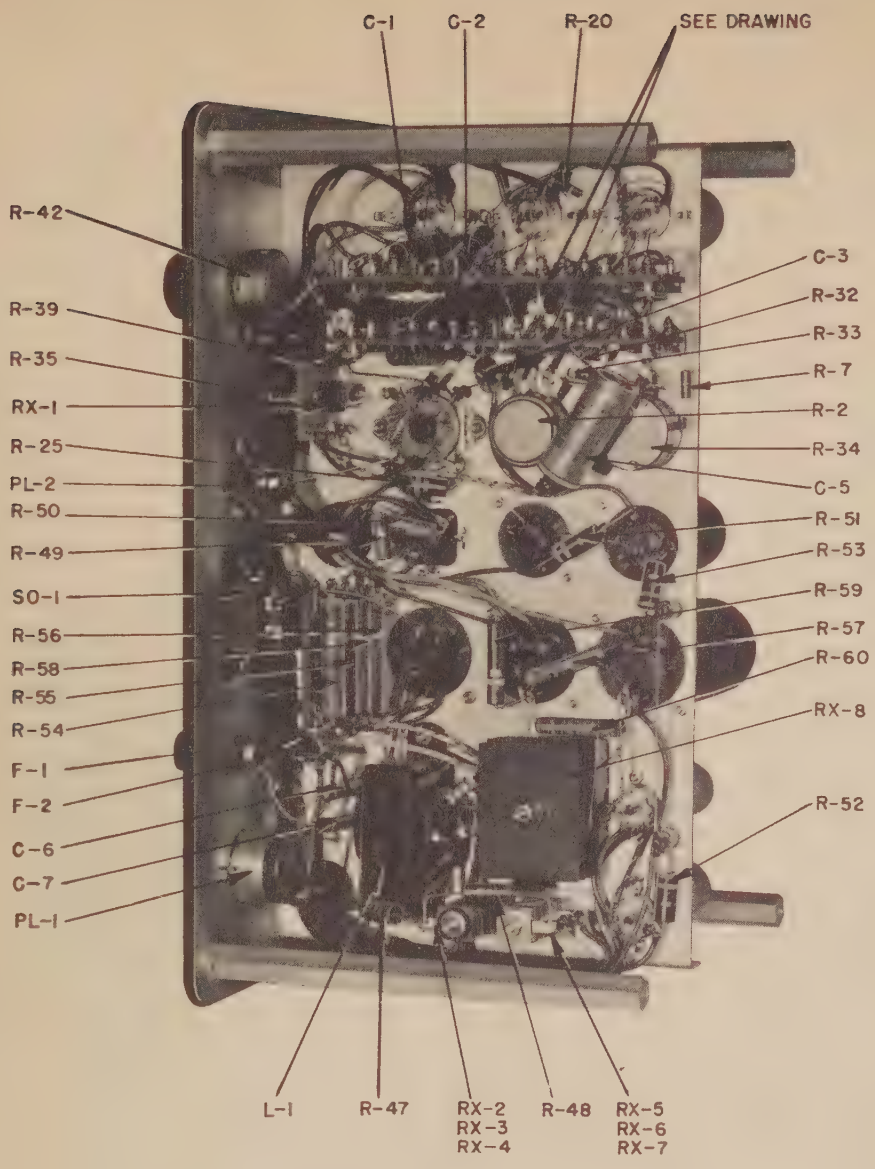
(C) All capacitances are in microfarads.

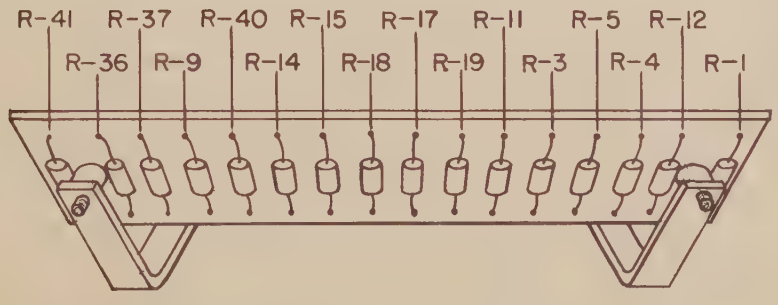
NCES ARE IN OHMS EXCEPT AS OTHERWISE
K(1000 OHMS) OR M(1,000,000 OHMS).
NCES ARE IN MICROFARADS.

S-1 PANEL ENGRAVING

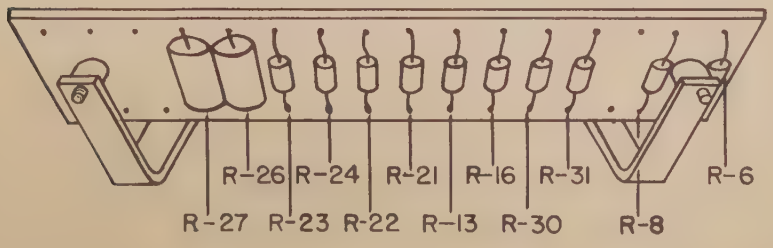
○ PANEL CONTROL

⊘ SCREW-DRIVER ADJUSTMENT





PANEL



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